**Evolutionary Genetics Revision Questions**

1. Define natural selection, gene flow, genetic drift, fixation and Hardy Weinberg equilibrium
2. Explain the differences between instantaneous and gradual speciation
3. Why is sexual reproduction more favoured over asexual reproduction in most animal species?

*Because if a female individual reproduces a copy of herself, she passes accumulated mutations that she has acquired throughout her life on to the clone. The offspring will accumulate more mutations in her life, therefore the amount of mutations increase each generation. This can be harmful as most mutations are deleterious.*

1. Outline the processes of Mitosis and Meiosis
2. When considering Chromosome number and DNA, a 1C value means what?

*1C value of an organism is the amount of DNA in an unreplicated haploid gamete (n)*

1. How do diploid gametes form?

*Diploid gametes form because the cells do not separate during mitosis or during meiosis, the cells do not divide during the first division or during the second division chromosomes do not segregate.*

1. *Tragopogon dubius* is 2n = 2x, what does this mean?

*2n means that the organism is acting as a diploid and 2x means that it is a diploid and not a polyploidy.*

1. What methods are there to visualise chromosomes and how can these be used to study chromosomes?

*Idiograms, drawing of a karyotype. C-banding with Barium hydroxide and Giemsa. G-banding with Pepsin and Giemsa. R-banding with Saline solution and Giemsa. Cells in hypotonic solution burst, releasing chromosomes which can then be visualised. Chromosome banding enables us to pair chromosomes and compare the banding pattern within and between species. Florescence In-situ hybridisation (FISH) can be used to identify specific DNA sequences on chromosomes*.

1. What is mitotic non-disjunction?

*During mitosis chromosomes do not segregate equally in a somatic body cell. This produces tissue with an altered chromosome number, therefore the organism is affected but the offspring is not as the event did not takes place in a germline cell.*

1. Explain how Meiotic non-disjunction can produce Polyploidy
2. Explain the difference between autopolyploidy and allopolyploidy
3. What are bivalents, trivalents and quadrivalents?
4. Explain polyploidy in *Primula kewensis*

*Study of Primula kewensisShas shown that allopolyploids are formed from interspecific hybridization and a polyploid event. P. floribunda and P. verticullata produce a sterile hybrid called P. kewensis. However a mitotic mistake that results in chromosome doubling caused P. kewensis to become a fully fertile natural polyploidy species.*

1. What are the disadvantages of being a polyploidy species?

*Twice as much DNA to copy, therefore there is an increased chance of mistakes occurring and there are fertility problems to overcome.*

1. Explain polyploidy in the genus *Brassica*
2. Explain polyploidy in *Trticum aestivum*
3. How does Colchicine affect mitotic cells?
4. When analysing the two parental genomes of tobacco using GISH (Genomic In situ Hybridisation) total DNA from each parent is labelled as a different colour. What chromosomal change would you expect to show chromosomes with both colours?

*Chromosomal Translocations*

1. What information is used for molecular clock calibration?

*The amount of mutations is an indication of age, more mutations of a gene suggest a longer time period since a common ancestor donated that gene. We can assume the mutation rate of DNA sequences.*

1. Explain Polyploidy in *Nicotiana*
2. Explain why putative homoploid hybrids in *Nicotiana* are not polyploid

*Because these species arose as a consequence of hybridization without a change in the chromosome number, therefore there is no polyploid event taking place.*

1. What are introgression characters?
2. Explain how quadrivalent formation may occur
3. Describe mammalian chromosome evolution, using specific chromosome visualising techniques as examples.
4. What is chromosome painting used for?
5. Define aneuploidy and give examples of four syndromes caused by human aneuploidy
6. What are B chromosomes? Comment on their inheritance, ancestry and the affect of accumulated B chromosomes.
7. Using examples discuss postglacial expansion in Europe and relate this to chromosome evolution
8. What is the origin of genetic variation?

*Mutations*

1. What are the two processes that affect mutations?

*Genetic drift and selection*

1. Why would two consecutive populations not have the same frequency for an allele?

*Unsuccessful mating, different number of offspring, death.*

1. Give an example of a form of natural selection maintaining polymorphism?

*Sickle cell anemia situation in Africa.*

1. Why may polymorphism be maintained across a habitat even if there is selection for different phenotypes in different areas of the habitat?

*Gene flow prevents selection from fixing one form of genetic variation as it introduces new alleles.*

1. Describe shell colour polymorphism in *Cepaea nemoralis*
2. What are the possible causes of polymorphism?
3. How can we determine if differences in allele frequencies of the polymorphic species Cepaea are due to genetic drift or selection?

**Polymorphism, Hardy Weinberg and Differentiation**

1. Using examples explain why polymorphism is considered the raw material of evolution
2. Why are populations polymorphic?

*Although drift tends to cause fixation of alleles, in large populations or a network of small populations connected via gene flow, this fixation may take so long that there is a significant period when more than one allele is present.*

1. Using examples explain how genetic markers may be used in population surveys
2. Describe the process of protein electrophoresis and how the results can be used in population surveys
3. Define frequency dependent selection using human left-handedness as an example
4. How do we know that the frequency of left-handedness has remained relatively unchanged?

*Because there is evidence from the analysis of ancient tools and hand prints which show that the frequency matches the current frequency.*

1. How is the Hardy-Weinberg principle used to relate allele frequencies to genotype frequencies? State assumptions made.
2. How can we detect deviations from Hardy-Weinberg expectations?
3. What is the Wahlund effect?
4. Explain how visual selection may act on *Cepaea*; is this a form of frequency dependent selection? Explain your reason.
5. How may climatic selection effect *Cepaea* differentiation?
6. How can the Hardy-Weinberg principle be used to assess the effects of population bottlenecks and founder events? Use example if necessary.
7. Why, when an allele is rare, does it tend to occur as a heterozygote?

**Bottlenecks and Coalescent**

1. How is expected heterozygosity calculated and what does it tell us about the population?

*Expected heterozygosity = 1 - ∑p2i*

*Were p2 is the expected frequency of homozygotes for each allele. Expected heterozygosity is a measure of how much genetic diversity there is in a population, since heterozygotes contain both forms of each allele as opposed to two of the same allele.*

1. How can the Hardy-Weinberg principle be used to find if bottlenecks can explain patterns of genetic data for cheaters?
2. How can we show the relationship between expected heterozygosity and population size?
3. What is meant by a coalescent event?
4. For any two genes in a population sample, if the most recent event in their ancestry is a coalescent, are they the same or different alleles?

*They are the same alleles, if a mutation event is before as coalescent then they would be different alleles.*

1. How do you calculate the probability of a mutation, coalescent probability and expected heterozygosity?

*Mutation probability = 2µ (µ = mutation rate)*

*Coalescent probability = 1/2N (N = population size (usually one tenth of actual population size))*

*Expected Heterozygosity = 2µ ÷ (2µ + 1/2N)*

*This can be used to show the relationship between heterozygosity and mutation rate.*

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